Information Disclosure Statement is filed herewith submitting these patents. Though considered of some interest to the invention of the present application, these newly cited references are not considered material to the subject matter of the present claims.

In connection with the present amendment, a complete set of claims is included in satisfaction of the objection raised in paragraph 2 of the Office Action, that the right side edges of the claims were cut off during printing. The claims are in the condition as originally filed, with the exception of changes made by amendment herewith.

Regarding the drawings, it is noted that the official draftsperson has approved the formal drawings as filed.

On page 4 of the Office Action, claims 1-5, 7-11, 13-24 and 26-30 were rejected under 35 U.S.C 102(b) as being anticipated by Kalsi U.S. Patent 4,484,753. In page 4 of the Office Action, it is stated "The sealing mechanism comprises a housing 43...". Item 43 in Kalsi '753 is not a housing, as the examiner states; instead, item 43 is an annular abutment ring for receiving the hydraulic thrust load imparted by lower seal support member 44. Reference numeral 16 of Kalsi '753 identifies the housing. The examiner further states that "seal carrier means 44 having grooves (upper and lower disclosed in Figure Descriptions), first and second annular resilient sealing elements 47 and 52". This is factually incorrect because the only grooves in lower seal support member 44 are provided for retention of annular felt seal rings 47, which exclude contaminant intrusion but do not provide a pressure sealing function. Kalsi '753 explicitly states as follows: *"A pair of annular felt seal rings 47 are illustrated spaced apart longitudinally on the inner facing wall of support member 44 for providing a barrier against the encroachment of drilling fluids into the lower end of seal assembly 41. While preventing the encroachment of such*

fluids in conjunction with a viscous material such as grease positioned thereabove, the felt seals are not sufficient to prevent the transmittal of pressure from the borehole annulus into the lower end of annular space 35." Since annular felt seal rings 47 do not seal pressure, it is not logical to compare them to the pressure-retaining seals of the present invention.

In comparing the claimed subject matter of the rejected claims with the Kalsi '753 reference, the examiner further states on page 4 of the Office Action "a staging pressure chamber 51, and means 48 communicating a second fluid at a staging pressure P2 at a fraction of P1 (see col. 8, lines 40-65)." A distinction between the staging pressure chamber in the present application, and what the examiner refers to in his comparison is that the seals of the present invention seal pressure, while the annular felt seal rings of Kalsi '753 explicitly do not seal pressure, which means that the felt wiper seals cannot define a staging pressure chamber as set forth in the present invention; see column 6, lines 5-15 of Kalsi '753, which states that *"the felt seals are not sufficient to prevent the transmittal of pressure from the borehole annulus into the lower end of annular space 35"*. Independent claims 1, 19 and 29 of the present application clearly recite that the seals of the present invention establish sealed relation with the <u>relatively rotatable member</u>. In contrast, the annular felt seal rings 47 of Kalsi '753 explicitly do not establish a sealed relation with the rotatable surface 14. Clearly, nothing in Kalsi '753 identifies or qualifies the seal carrier apparatus for fluid pressure staging.

Further, the examiner is in error concerning his statement about item 48 in Kalsi 753, which states *"Port 48 is provided through the wall of housing 16 to accommodate the insertion of grease into annular space 35 and is arranged with a fitting to seal the port closed when grease is not being injected."* Kalsi '753 goes on to state, *"Grease injection port and fitting 48*

provides for the filling of annular space 35 at the lower end of the seal assembly with a viscous material." Clearly, port 48 is only used to insert or inject grease into the region between annular felt seal rings 47 and lower seal member 52 for purposes other than pressure staging, particularly in view of the following statement in Kalsi '753: *"A pair of annular felt seal rings 47 are illustrated spaced apart longitudinally on the inner facing wall of support member 44 for providing a barrier against the encroachment of drilling fluids into the lower end of seal assembly 41. While preventing the encroachment of such fluids in conjunction with a viscous material such as grease positioned thereabove, the felt seals are not sufficient to prevent the transmittal of pressure from the borehole annulus into the lower end of annular space 35."* Accordingly, any claims rejected on the basis of the examiner's misconception should be allowed, including claims 1, 19 and 29.

The paragraphs the examiner references "Column 8, lines 40-65" do not state that means 48 communicates a second fluid at a staging pressure; in fact they do not mention 48 at all. Accordingly, any such use of the referenced text to reject the claims is without proper foundation, and any claims rejected on the basis of the referenced text should be allowed.

The examiner is incorrect in his statement on page 4 of the Office Action that "The first and second seal carriers 44 are substantially hydraulically balanced in the axial direction". First of all, there are no "first and second" item 44 shown; there is only one item 44 shown. Secondly, item 44, which is referred to as *"lower seal support member 44"* in the text, for supporting *"lower seal member 52"* is definitely not substantially hydraulically balanced in the axial direction. Rather, the wellbore pressure acting over area A1 creates a downwardly acting axial force that is substantially greater than the opposing axial force created by well annulus pressure

acting over area A2. As a result of this imbalanced hydraulic force, lower surface 64 of upper annular support member 59 pushes downward on upper surface 53 of lower seal support member 44 through upper seal member 66 and lower seal member 52 in order to expand them to compensate for seal wear. This downwardly acting hydraulic force is reacted to annular abutment ring 43, which in turn reacts the force to housing 16. In this regard the Kalsi 753 patent states *"When a drilling tool having a seal assembly in accordance with the present invention as described above is operated, a pressure differential is developed across the tool whereby a higher pressure exists in the section of the tool above the drill bit than exists below the bit. The higher pressure in this tool is communicated to the upper end of bearing and sealing sub 11 (FIG. 1) by means of piston 21 at the upper end of sub 11. This pressure is carried by the lubricant in chambers 28 throughout sub 11 to the lower end of the sub bordering seal assembly 41. Referring now to FIG. 2, this pressure is passed to the upper end of upper support member 59 and acts downwardly across the area A_1. This downward force is passed to the top surface of seals 52 and 66. Bottom support member 44 is held against downward movement by abutment ring 43, thus compressing the seal between upper and lower support members 59 and 44, respectively. As the inner facing surfaces of seals 52 and 66 wear, the predictable force between the support members is appropriately closing the groove defined by surfaces 53 and 64 to continuously maintain the seal confined as it wears down and to press the seal into sealing engagement with the shaft and upper support member"*. Accordingly, it is respectfully submitted that claims 2 and 18, which specifically recite at least one of first and second seal carriers as being hydraulically force balanced, are allowable since they establish clear distinction in comparison with the teachings of the prior art of record.

About the middle of page 4 of the Office Action it is stated, with respect to Kalsi '754: "The first and second seal carriers 44 are substantially hydraulically balanced in the radial direction. A bulkhead 59 is located in sealed relation to the housing and defining axially spaced annular seal carrier recesses (formed by the L-shaped cutout containing the carriers 44)". The plurality of recesses and the plurality of items 44 recited by the examiner is factually incorrect. Item 44 is an annular lower seal support member which has an upper portion 46 interfitting within an internal recess defined by an annular upper seal support member. The upper annular section 46 of the lower seal support member 44 serves as an annular retainer to retain a seal assembly including an upper seal 66 and a lower seal 52 for sealing engagement with the outer surface of the shaft 14 and to configure the seals according to the broken line illustration for hydrodynamic lubricating activity responsive to shaft rotation. Only a single seal support member 44 exists; not a plurality of seals 44 as is stated in the Office Action. Upper seal support member does not serve as a bulkhead in any manner whatever. Thus, it is respectfully requested that the examiner carefully consider the seal support and orientation system of the '753 reference and reconsider its application to the claimed subject matter hereof. Further, the annular seals 63 and 30 of the upper and lower seal support members are <u>static seals</u> for sealing with the internal surface of the seal recess of the housing member 16. The upper and lower seal support members of the '753 reference do not have relative rotation with respect to the housing 16. Accordingly, all claims rejected on that misconception should be allowed, such as claim 3, 10, 20, 21, and 29.

The examiner's statement that "The bulkhead 59 is substantially hydraulically force balanced in the radial direction" is incorrect. Over 1/3 of upper annular support member 59 is not hydraulically pressure balanced in the radial direction.

The examiner has stated in page 4 of the Office Action that "A first fluid circulation passage (passage formed by member 43 and the rotatable surface 14) circulated the first fluid and a second fluid circulation passage (opening) 51 circulate the second fluid." Kalsi '753 does not mention fluid circulation at the locations the examiner recites; the examiner has apparently determined that spaces and openings are passages, in an attempt to read the Kalsi '753 reference on applicant's present disclosure, even when Kalsi '753 does not intend that fluid circulation occur. Secondly, the annular felt seals 47 cannot seal pressure, as discussed in more detail above. Thirdly, item 51 is identified in the '753 patent as a port permitting grease to be injected for communication to the inner side of the support member 44. Clearly the port is only a hole and a hole does not define a passage for circulation; it takes an inlet and an outlet to achieve circulation of the so-called second fluid. For circulation to occur, the only potential exit is the felt seals, and if it is accepted that they do not hold pressure, as stated in Kalsi '753, then they certainly do not qualify as a sealing partition between the so called first fluid and second fluid; it all becomes one fluid, i.e. the wellbore fluid since the space between 43 and 14 is the wellbore, and item 48 is exposed to the wellbore. Using the reasoning of the examiner, the so called first and second fluids are actually one and the same fluid and his argument logic is therefore without proper foundation in the prior art.

Beginning 6 lines from the bottom of page 4 of the Office Action it is stated: "An outboard seal 30 establishes low pressure sealing with respect to the rotatable surface (outside surface) and defining a cooling chamber (between 51 and 48)". It should be borne in mind that the outboard seal of the present invention is seal 122, which is shown at the upper end of Fig. 1. This outboard seal is shown and described as having sealing engagement with a rotary shaft. In

comparison, the seal 30, which is referred to in the Office Action as an outboard seal, is simply a static seal which, together with the static seal 63 of the upper seal support member, confines lubricant injected through grease fitting 48 into the annular space between the internal housing surface and the upper and lower seal support members 59 and 44. Since the static seals 30 and 63 are not "rotary outboard seals" within the meaning of the claim language, it is logical that the claim language is not anticipated by the teachings of Kalsi '753.

The examiner has stated further in page 4 of the Office Action that "A cooling passage (fluid circulation path) (formed between carrier 44 and housing 16) is disposed in fluid circulation communicating with the cooling chamber for circulation of the coolant fluid within the cooling chamber". A careful reading of Kalsi '743 will clearly confirm that there is no fluid circulation in the region the examiner speaks of, nor does Kalsi '753 intend that circulation of coolant occur. Kalsi '753 doesn't define the area as a coolant circulation path, contrary to the apparent opinion of the examiner. There is only provision for lubrication, not circulation. In this regard, it is respectfully requested that only the actual teachings of Kalsi '753 be compared with the present invention.

Element 32a is defined in the text of '753 as a thrust bearing, and is illustrated as a standard rolling element thrust bearing as commonly used in mud motor sealed bearing assemblies. Element 32a is certainly not a journal bearing as the examiner has stated in the last line of page 4 of the Office Action. Accordingly, claims 13 and 14, which specifically call for a journal bearing should be allowed.

It is stated in the upper few lines of page 5 of the Office Action that: "The lower or upper carrier means 44 can be viewed as a single seal carrier 44 supporting the first and second annular

resilient sealing elements 47 and 52." Clearly, there is no upper and lower support member 44 shown in Kalsi '753 (support member 44 is an integral seal support), and annular felt seal rings 47 of Kalsi '753 explicitly do not establish a sealed relation with the shaft 14 (as stated in Column 6, lines 12-14), so there exists no valid comparison of the teachings of Kalsi '753 with the present invention. Rather, Kalsi '753 seems to have been applied by the examiner only in light of the claimed subject matter of the present application and not with regard to the actual teachings of Kalsi '753. Accordingly, claims, 17 and 26, which specifically recite a single seal carrier, clearly differentiate from the teachings of the prior art and thus are considered clearly allowable as presented herewith.

On page 5, lines 3 and 4 of the Office Action, the text referenced by the examiner does not identify circulation means for a first fluid, rather the text identified by the examiner references drilling fluid pressure communication through the tool, from the drilling fluid pressure, to the lubricant via the piston 21. This pressure communication should not be confused with fluid flow, which does not occur in the rotary shaft seal assembly of Kalsi '753. The seal of the "seal assembly in accordance with the present invention", which is mentioned in column 8, lines 16 and 17 of Kalsi '753, is a hydrodynamic seal which is designed to develop a hydrodynamic wedging action which causes migration of lubricant within the sealing interface of the seal with the shaft in response to rotation of the shaft to provide for lubrication and to thus minimize heat buildup. No flow of coolant occurs in the seal assembly of Kalsi '753 within the context of the present invention. No coolant inlets and outlets are provided and no passage is provided for the flow of a coolant within the seal assembly. The pressure that is mentioned is the pressure of the well fluid, not the pressure of a coolant or lubricant for the purpose of pressure

staging. Piston 21 serves as a partition between the drilling fluid in the wellbore and the bearing lubricant within the housing 16; if fluid circulation were to occur, piston 21 would bottom out in it's stroke. Accordingly, claims 18 and 27 which specifically recite "means circulating said first fluid for cooling" are clearly and patentably distinguishable from the teachings of Kalsi '753 and are thus allowable.

Claims 1-12, 14,16 7-18-25 and 27-30 were rejected under 35 U.S.C. 102(b) as being anticipated by the publication of M.S. Kalsi, PhD, SPE, W. T. Conroy, L. L. Dietle, and J. D. Gobeli (Kalsi et al), all of Kalsi Engineering, Inc. entitled "A Novel High-Pressure Rotary Shaft Seal Facilitates Innovations in Drilling and Production Equipment". The examiner has stated that "The Kalsi article shows all of the claimed subject matter of a sealing mechanism in Figures 8 and 12". Applicants take exception to the examiner's position in this regard, because Figure 8 of the article does not show a laterally translatable seal carrier that is also pressure staged, which is the essence of the present invention. Note that the caption of Fig 8 of Kalsi et al indicates "patented". The subject matter of Figure 8 is covered by U.S. Patent No. 5,195,754 of Dietle. No pressure staged laterally translating seal carrier is disclosed or intended by the laterally translating seal carrier apparatus of Figure 12. The present invention improves upon the field-proven laterally translating seal carrier of the Figure 8 concept to enable the seal carrier to handle even higher pressures. In this regard, the present application states, beginning in page 4, line 8: "Briefly, the present invention is a laterally translatable pressure staged rotary shaft sealing mechanism which is an improvement over the hydraulic force balanced, laterally translating rotary seal carrier assembly of commonly assigned U.S. Patent 5,195,754."

Further, since Mr. Dietle is the designer of the seal carrier apparatus shown in Figure 12 of the Kalsi et al publication and as such is intimately familiar with the design intent and resulting performance of the seal carrier that is shown.

The examiner has made some inaccurate statements in the sentence beginning with "The sealing mechanism comprises..." about the middle of page 5 of the Office Action. It is believed that the examiner's statement is directed to Figure. 12 of the article of Kalsi et al. The examiner's statement is incorrect in a very important way: there is no staging pressure chamber, and there is no means communicating a second fluid at a staging pressure at a fraction of the process fluid pressure. Rather, the pressure of the lubricant located between the seals is amplified above the process fluid pressure by the force provided by the coil spring acting on the equalizing piston. This amplification of the pressure of the process fluid between two seals is actually opposite the pressure staging system of the present invention. Accordingly, any claims rejected under this mistaken conception should be allowed; such as claims 1 , 19 and 29.

Another important error the examiner makes in this sentence is to assume that the seal carrier in Figure 12 of the Kalsi article is laterally translatable; in reality, during operation the seal carrier is held firmly in fixed location by the pressure of the process fluid acting over the area between the effective sealing diameter of the face seal and the washpipe outer diameter. The only lateral translation of the seal carrier occurs at the time of installation of the washpipe assembly, when a special procedure is used to align the seal carrier with respect to the seal carrier. Thus, since the seal carrier of Figure 12 cannot translate laterally once process fluid pressure is applied, the seal carrier cannot be said to be either substantially pressure balanced, or

laterally translatable. In Figure 12 of the Kalsi article (and Figure 8 for that matter) only a single seal carrier is shown. The examiner's inference that two seal carriers are shown is not accurate.

See above for a discussion of how the seal carrier of Figure. 12 is not substantially hydraulically balanced in the axial direction. It is believed that the examiner's comment is directed particularly to claims 2, 16, 17, and 22. These claims, however, are directed to a laterally translatable seal carrier that is pressure staged, a feature that is not taught or inherently suggested by the teachings of the Kalsi article. Regarding the bulkhead mentioned on page 5 of the Office Action it is stated: "A bulkhead (center square between the two carriers) is located in sealed relation to the housing and defining axially spaced annular seal carrier recesses. The bulkhead is substantially hydraulically force balanced in the radial direction". The examiner has misinterpreted Figure 12 of the Kalsi article because there simply is no bulkhead present between two seal carriers shown in Figure 12. The "center square" mentioned by the examiner cannot be said to constitute a bulkhead since it does not provide for separation of anything. The center square shown in the Figure is simply a part of the integral tubular element shown in cross-section. The integral tubular element defines lubricant ports to provide for lubrication of the sealing interface of the spaced hydrodynamic seals with the rotary washpipe. Since there is no bulkhead, it cannot be substantially hydraulically force balanced in the radial direction, and it cannot define axially spaced annular seal carrier recesses. Any claims rejected on the basis of a bulkhead shown in Figure 12 of the Kalsi article should be allowed, such as claims 3, 4, 10, 20, 21, and 29.

The examiner is correct in the statement that "The first and second annular resilient sealing elements establish substantially equal sealing diameters with rotatable surface".

However, the seals shown in Figure 12 of the Kalsi article are not pressure staged as specifically recited in the in the present application. Accordingly, claim 5 is clearly allowable over the teachings of the Kalsi article.

In the sentence beginning in the fourth line from the bottom on page 5 of the Office Action, it is stated: "A first fluid circulation passage circulated the first fluid and a second fluid circulation passage circulate the second fluid." As in many applications, the process fluid in Figure 8 of the Kalsi article moves through the rotating shaft; i.e. the washpipe. Such through-shaft circulation is indeed a great benefit to the seals of Figure 12 because it draws heat away from the seals in a highly efficient manner. The present invention, however, does not claim circulation through the shaft or washpipe. In the assembly of Figure 12 of the Kalsi article, neither the lubricant or the process fluid is caused to circulate around the seal carrier. The process fluid cavity which contains the coil spring is a stagnant, non-circulating cavity. Likewise, the lubricant chamber below the equalizing piston is a stagnant, non-circulating cavity. Since fluid circulation is not evident in Figures 8 and 12 of the Kalsi article, consideration of these Figures to anticipate the claimed subject matter is not proper. Reconsideration of this ground of rejection is therefore respectfully requested.

In the last complete sentence on page 5 of the Office Action, it is stated: "An outboard seal (static seals not against the rotating washpipe) establishes a low pressure sealing with respect to the rotatable surface (outside surface) and defining a cooling chamber. A cooling passage (fluid circulation path at top right) is disposed in fluid circulation communicating with the cooling chamber for circulation of the coolant fluid within the cooling chamber." This comment appears to be directed against dependent claims 8 and 23, but is not suitable grounds for rejecting

claims 8 and 23 since both claims specifically call for an outboard seal establishing sealing with the same relatively rotatable member engaged by the first and second annular resilient sealing elements) and defining a cooling chamber. This statement admits discussion of "static seals not against the rotating washpipe"; however it is clear that the outboard seal set forth in the claim language is a rotary seal, with the outboard seal in sealing contact with the rotary washpipe. In this regard, it should be noted that claim 23 has been amended herewith to recite an outboard seal establishing low pressure sealing with said relatively rotatable member and defining a cooling chamber outboard of said first and second annular resilient sealing elements. Accordingly, reconsideration of this ground of rejection is therefore respectfully requested.

The washpipe assembly in Figure 8 of Kalsi et al has no source of circulating coolant fluid at a low pressure because the process fluid is at high pressure and the lubricant pressure is spring-amplified to a pressure higher than the process fluid pressure. Claim 8 has been amended herewith to recite "a source of circulating coolant fluid at a pressure lower than said pressure P2 of said second fluid. Claim 8 is therefore clearly distinguishable from the teachings of Kalsi et al in this regard and is thus considered allowable as presented herewith. Additionally, claim 23 has been amended herewith by adding a recitation that "a cooling fluid at a pressure lower than said pressure P2 of said second fluid", and a "a cooling [passage] path being disposed in fluid circulation communication with said cooling chamber for circulation of said cooling [coolant] fluid within said cooling chamber for cooling". Thus claims 8 and 23 are considered allowable as presented herewith.

On page 6 of the Office Action, beginning in the second line, it is stated "Means (lower insertion nozzle) circulating the first fluid for cooling the first and second annular resilient

sealing elements." The assembly of Figure 12 of the Kalsi et al publication does not have means for circulating the lubricant; that would require an inlet and an outlet, and the assembly of Figure 12 only has a single port, which is used for lubricant filling and refilling. It should be noted that dependent claims 18 and 27 have been amended herewith to state that said first fluid is a lubricant. This specifically recited feature is supported by the specification, which states "First fluid 4 is preferably a lubricant.". Thus, claims 18 and 27 are clearly allowable over the teachings of the Kalsi et al publication.

In line 4 of page 6 of the Office Action it is stated in regard to Figure 12 of Kalsi et al that "The first and second annular resilient sealing elements can establish unequal sealing diameter when the top or second resilient sealing element is moved to the tapered part of the rotatable surface." This, however, is not a teaching of the Kalsi et al reference. The tapered part of the rotatable surface of Figure 12 is a common, ordinary seal installation chamfer. Nothing in Kalsi et al suggests that the top resilient sealing element should run on the tapered portion of the rotatable surface; in fact if such a thing were attempted the sealing element would not be able to establish a proper seal with respect to the rotatable surface because the sealing element would not be in proper radial compression. Nothing in Kalsi et al suggests that the first and second annular resilient sealing elements do or should establish unequal sealing diameters with the relatively rotatable surface of Figure. 12. Accordingly, claim 6 is clearly allowable over the teachings of the publication of Kalsi et al.

The prior art patents to Pondelick et al U.S. Patent 5, 527,045 and Titus U.S. Patent 5,199,514 have been carefully considered. It is respectfully submitted that the claims of the

present application, as amended herewith, establish clear and patentable distinction over the teachings of these references.

In view of the foregoing, it is respectfully submitted that all of the claims of this application, as presented herewith, are clearly and patentably distinguishable over the teachings of all of the references of record, whether taken alone or in combination. Allowance of the claims hereof together with subsequent grant of Letters Patent is therefore respectfully solicited.

Respectfully submitted,

James L. Jackson
Reg. No. 20,791

Mayor, Day, Caldwell & Keeton, L.L.P.
700 Louisiana, Suite 1900
Houston, Texas 77002-7047
Telephone: (713) 225-7186

Date: 10/27/2000